Understanding the meso-scale drivers and their effects on the I-T system during the 2 March, 2017 event

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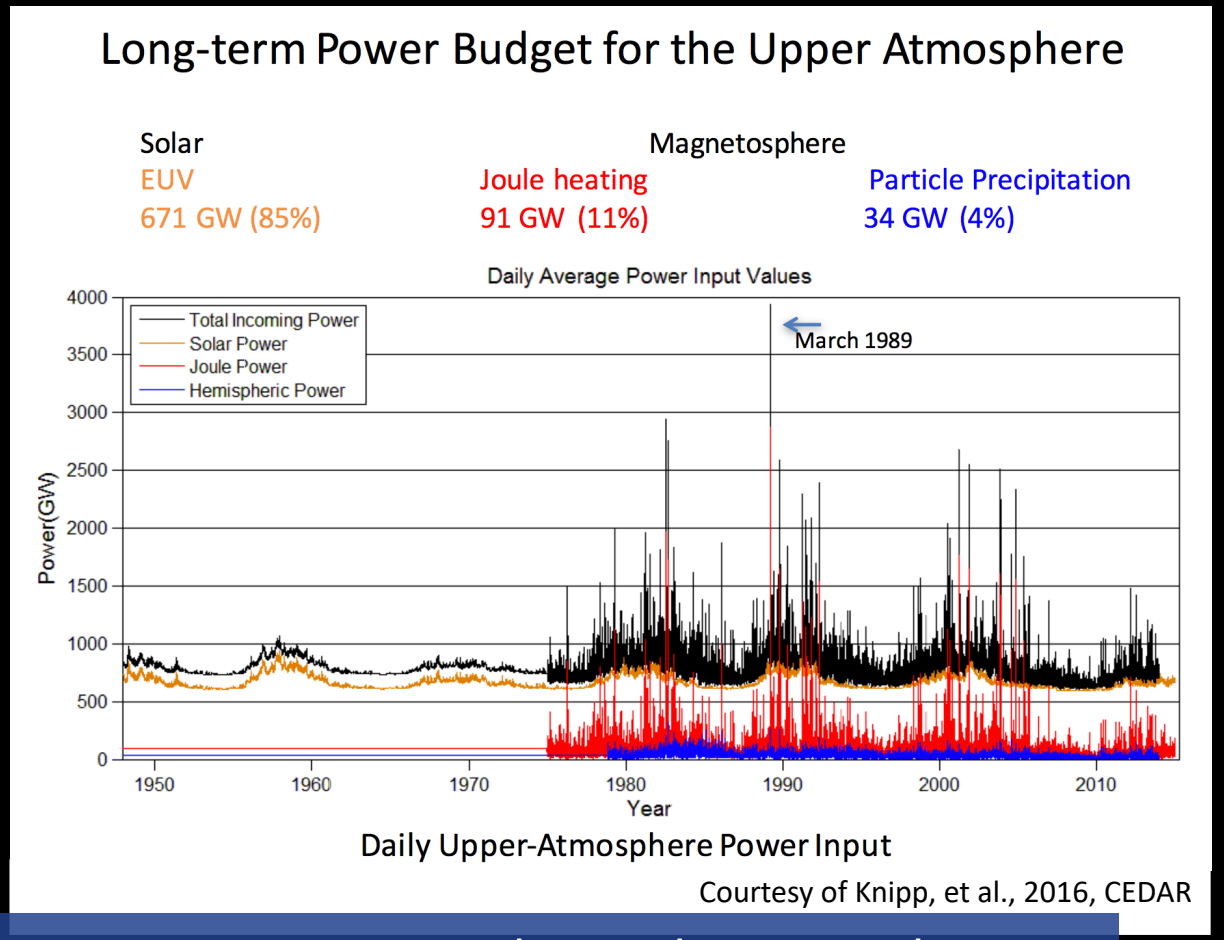
M-I-T Coupling at Meso-scale*

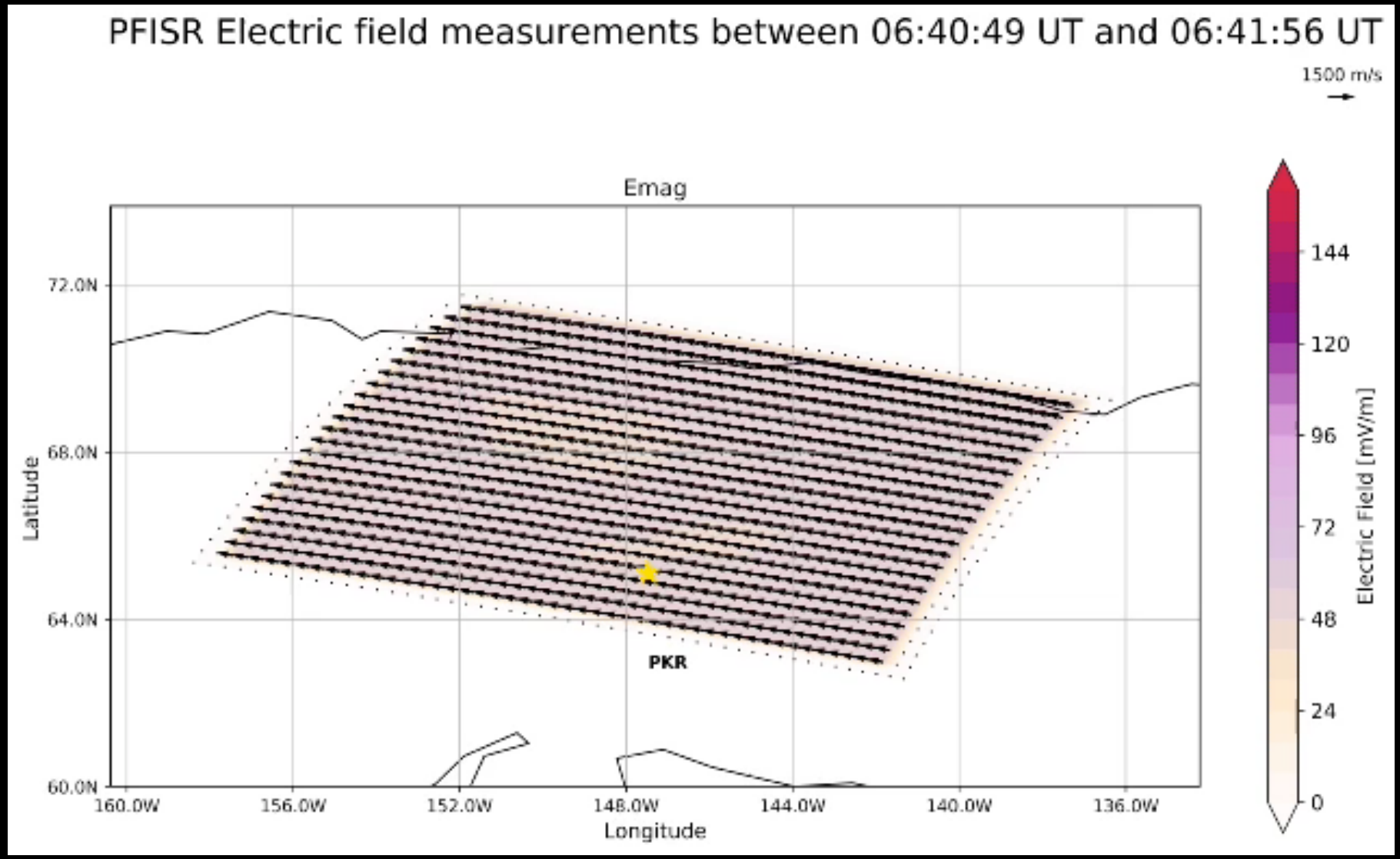
- Electromagnetic energy input can be due to different magnetospheric drivers
- Joule heating ($\sigma_p E^2$) and particle precipitation are important for estimating the energy budget for I-T system
- Traditionally, conductivity and electric fields are estimated through empirical models. The current empirical models can not resolve the meso-scale structures but significant work is ongoing to develop models that can resolve them [Codrescu et al. 2008; Deng et al. 2009; Matsuo & Richmond 2008; Zhu et al. 2018].
- Not resolving meso-scale electric field variability (temporal+spatial) → underestimated Joule Heating



Can we understand the role of the meso-scale structures on I-T system better by using electric field measurements?

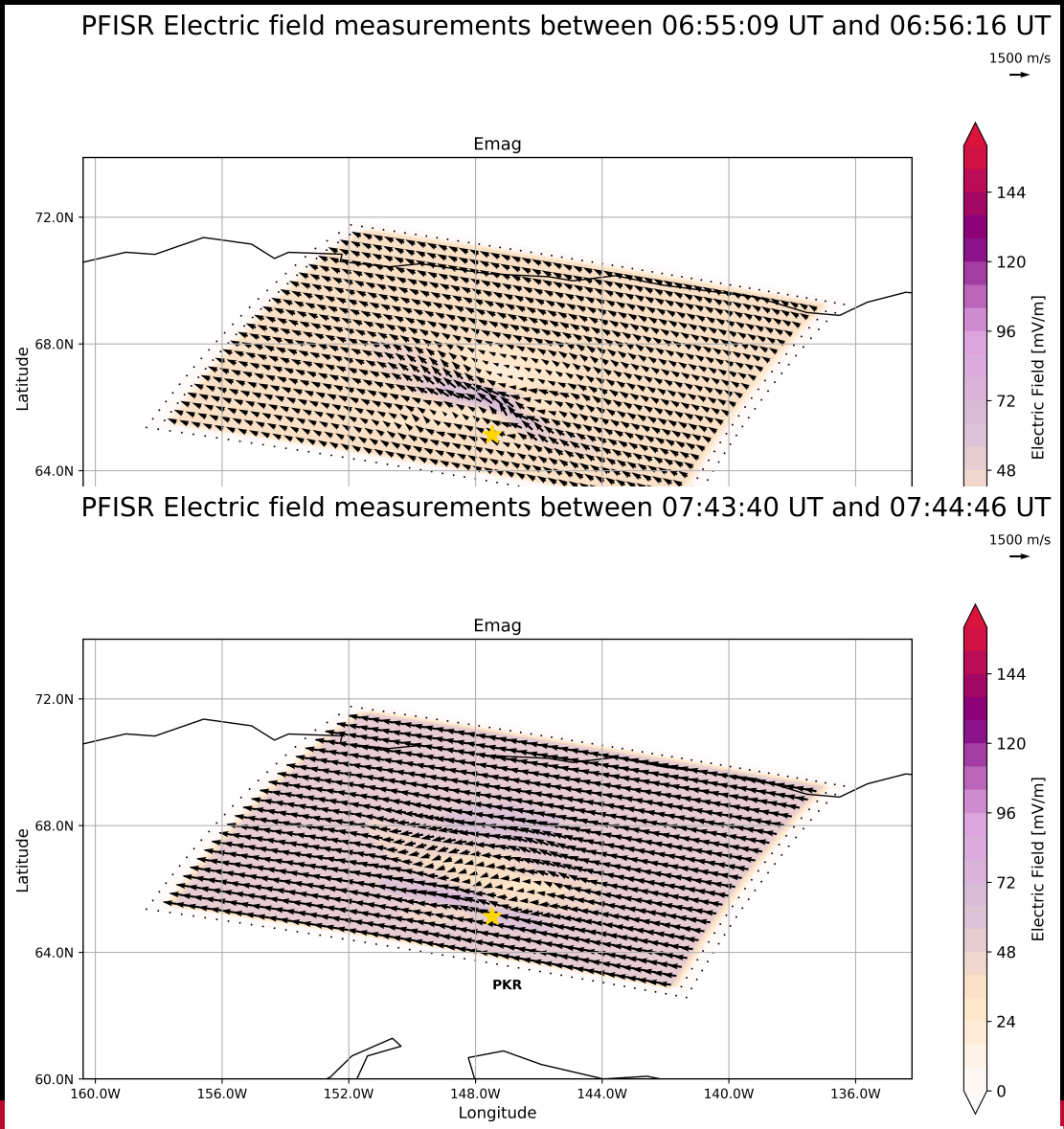
* Spatial scale between 100-250 km, temporal scale below 15 minutes

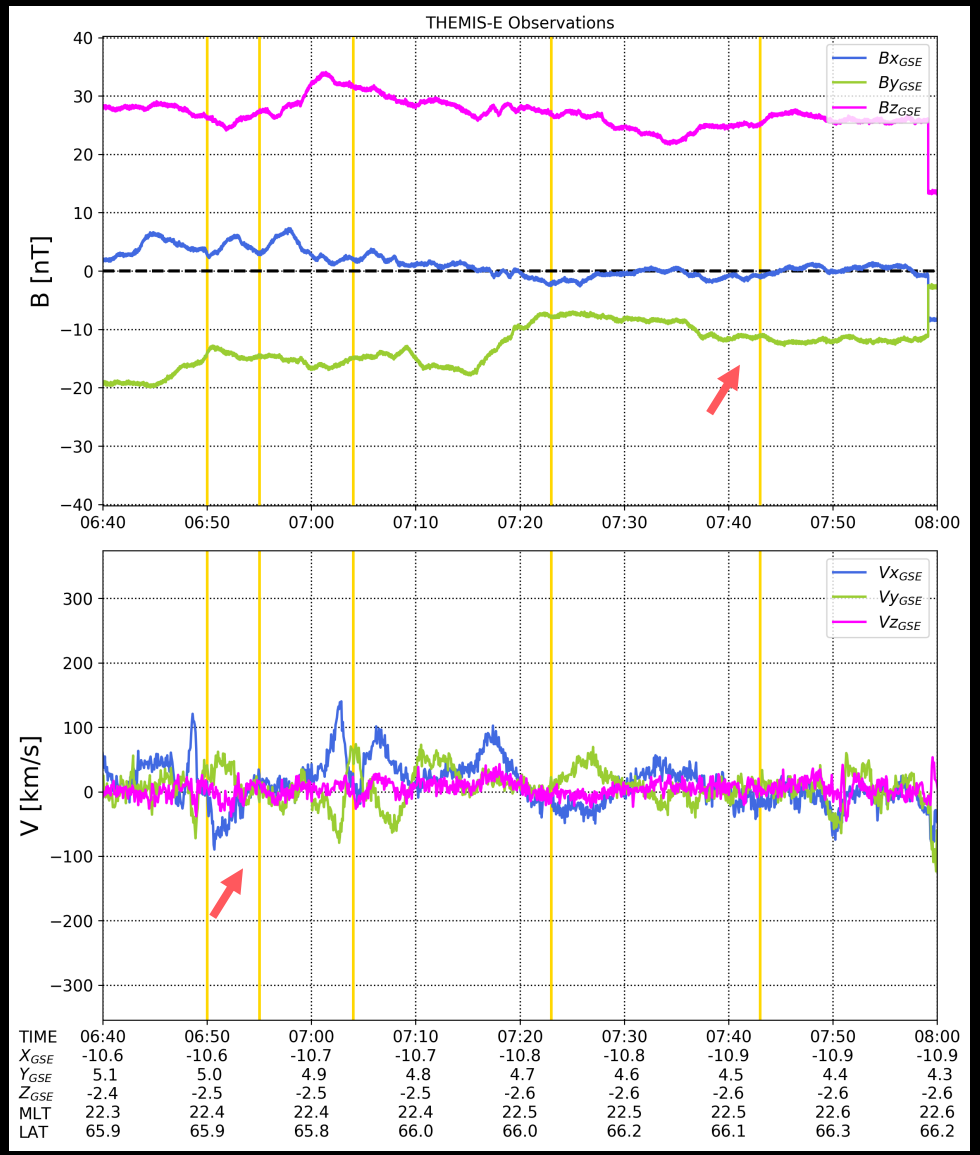
PFISR Electric Field observations between 0640-0800 UT



- Temporal variability [66 seconds]
- Spatial variability [0.05° in latitude and 0.3° in longitude, 100 km]
- Many short-lived structures during the period
- PFISR aiding the ISINGLASS experiment [Lynch et al.]

Solar wind and magnetospheric conditions during the March 2, 2017 Event





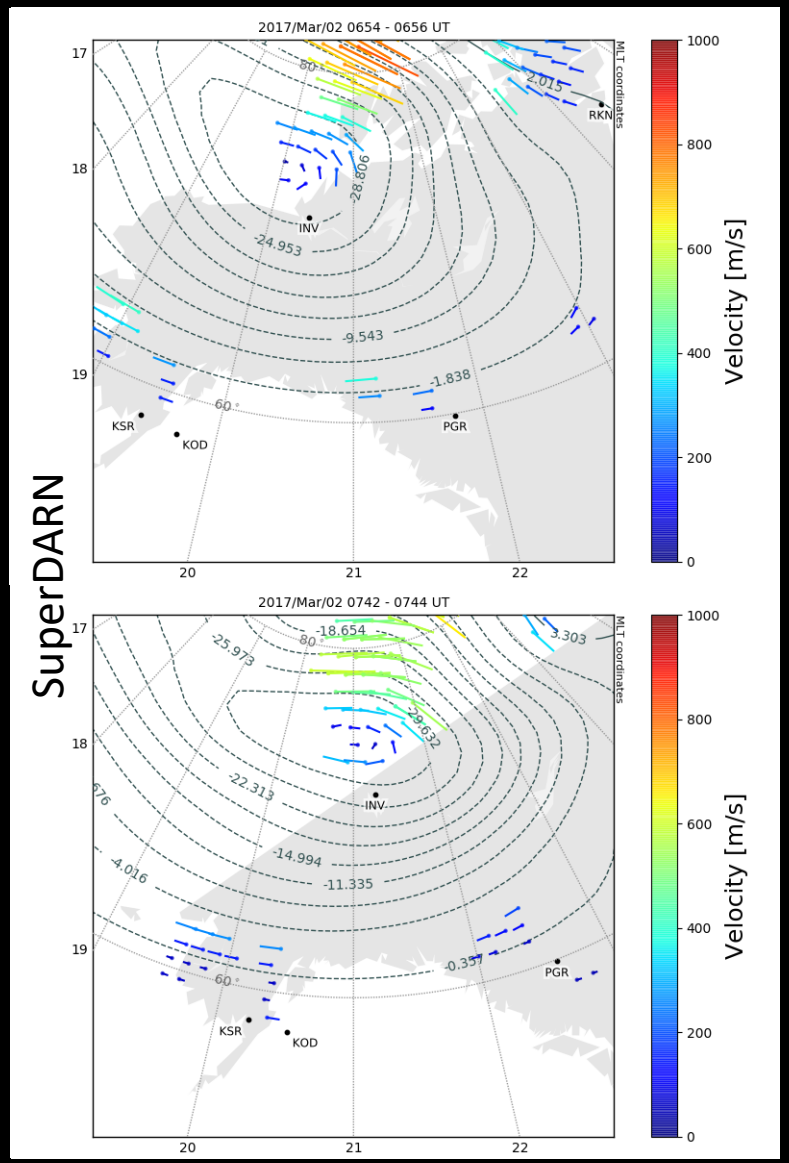
TIME	06:40	06:50	07:00	07:10	07:20	07:30	07:40	07:50	08:00
X_{GSE}	-10.6	-10.6	-10.7	-10.7	-10.8	-10.8	-10.9	-10.9	-10.9
Y_{GSE}	5.1	5.0	4.9	4.8	4.7	4.6	4.5	4.4	4.3
Z_{GSE}	-2.4	-2.5	-2.5	-2.5	-2.6	-2.6	-2.6	-2.6	-2.6
MLT	22.3	22.4	22.4	22.4	22.5	22.5	22.5	22.6	22.6
LAT	65.9	65.9	65.8	66.0	66.0	66.2	66.1	66.3	66.2

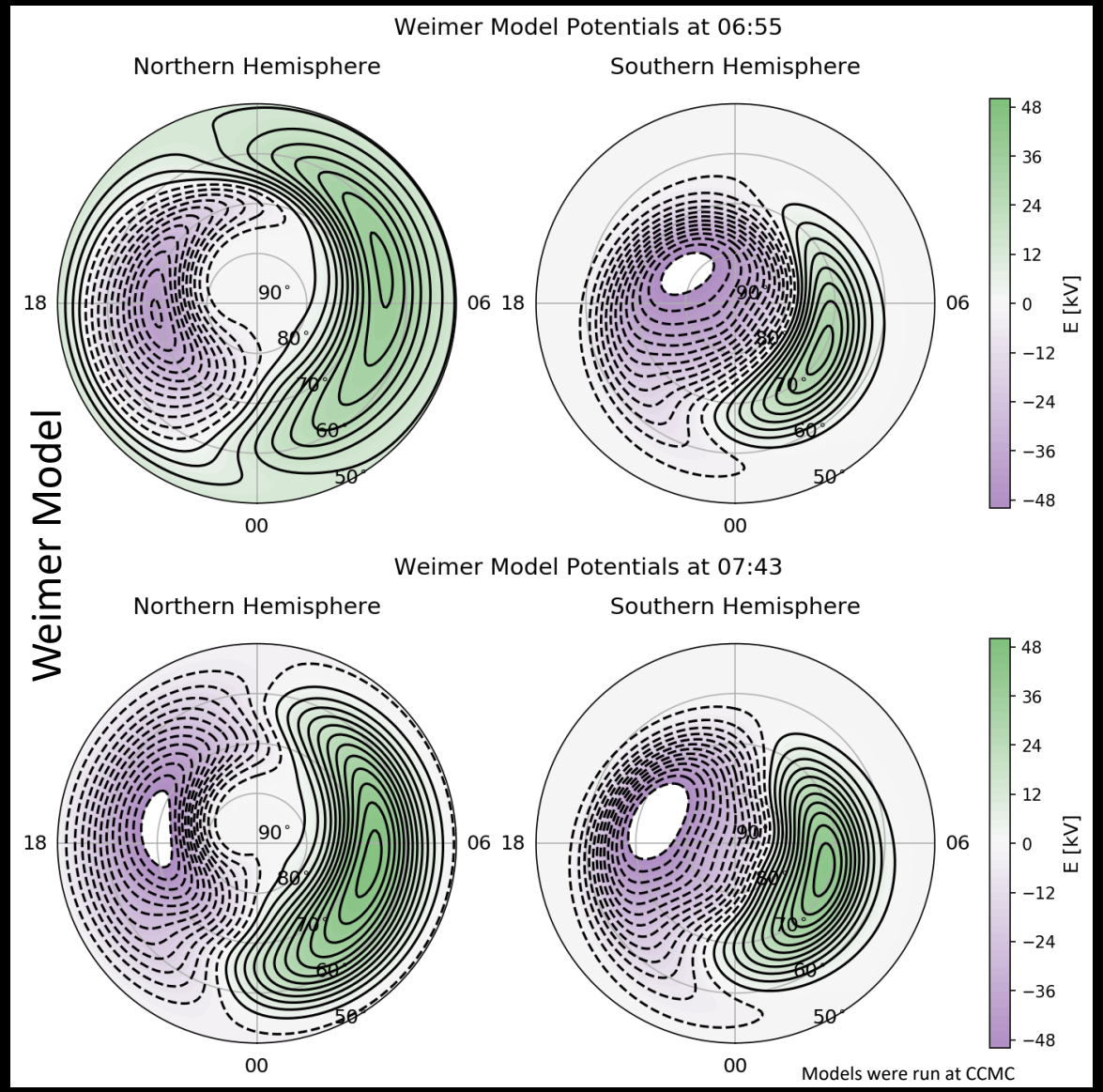
- Recovery phase of a storm with a minimum Dst of -61 nT
- Multiple small-amplitude flow enhancements
- Two current sheet crossings
- Two intervals around 0655 UT and 0743 UT

* Yellow lines indicate times of strong variability in PFISR electric fields.

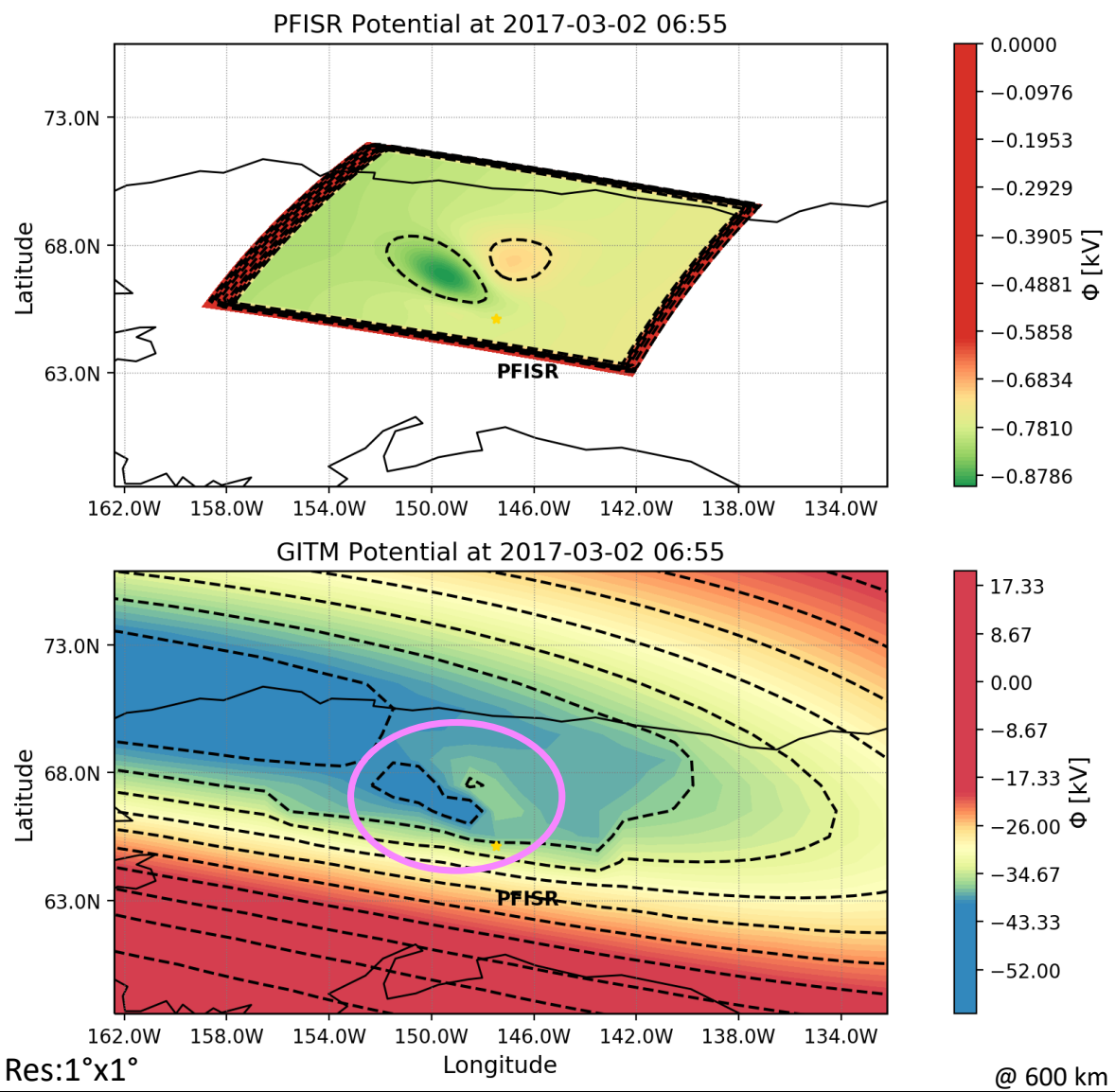
Global Ion Convection Fields: SuperDARN vs Weimer Model

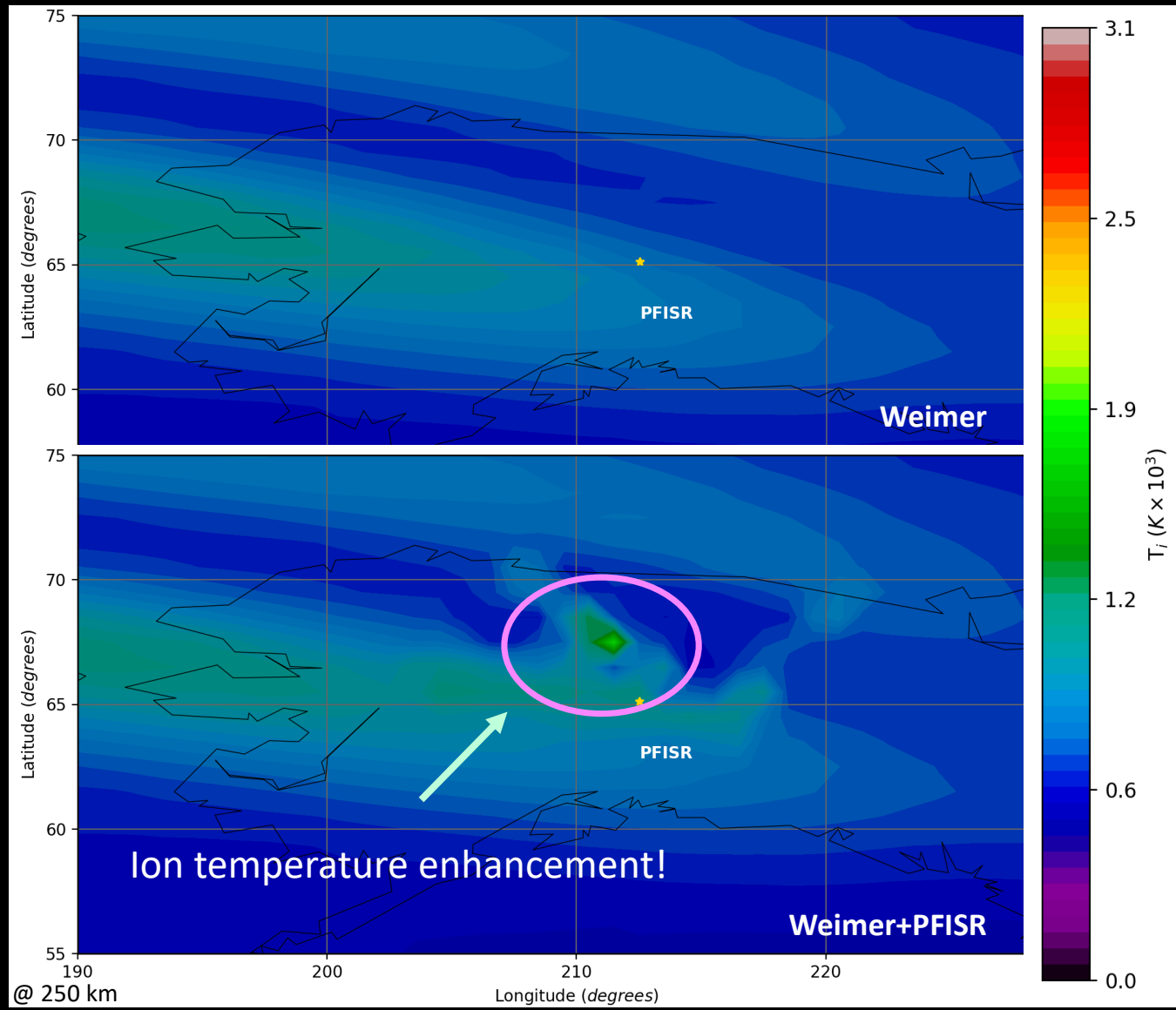
- SuperDARN shows changes in electric potentials and ion convection flows. (<1 MLT, 5 ° MLAT)
- Weimer model shows the response to IMF clock angle but does not demonstrate the meso-scale variability.
- The E-field variability at the Ionosphere can be due to the magnetic activity at the magnetotail.



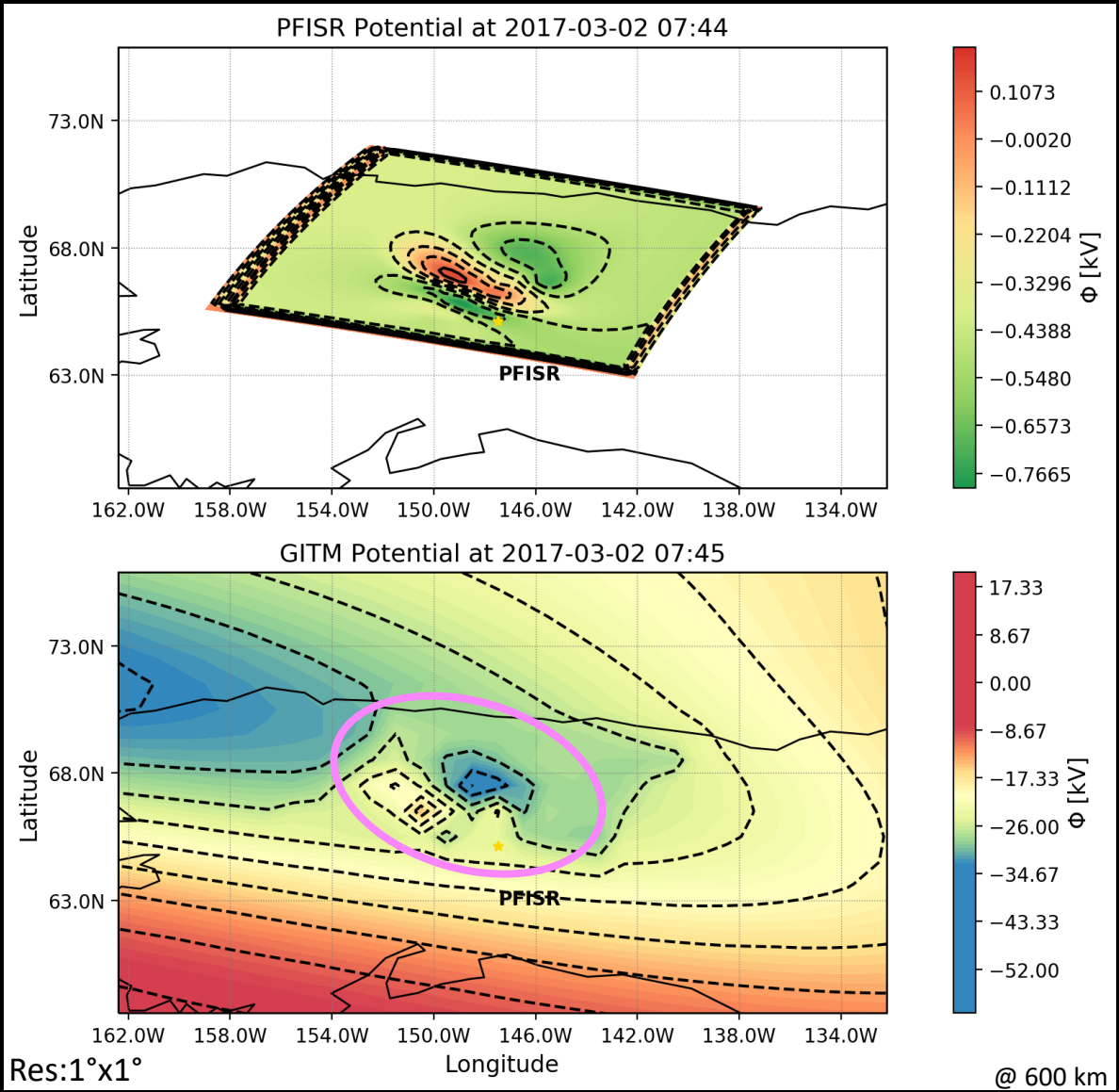


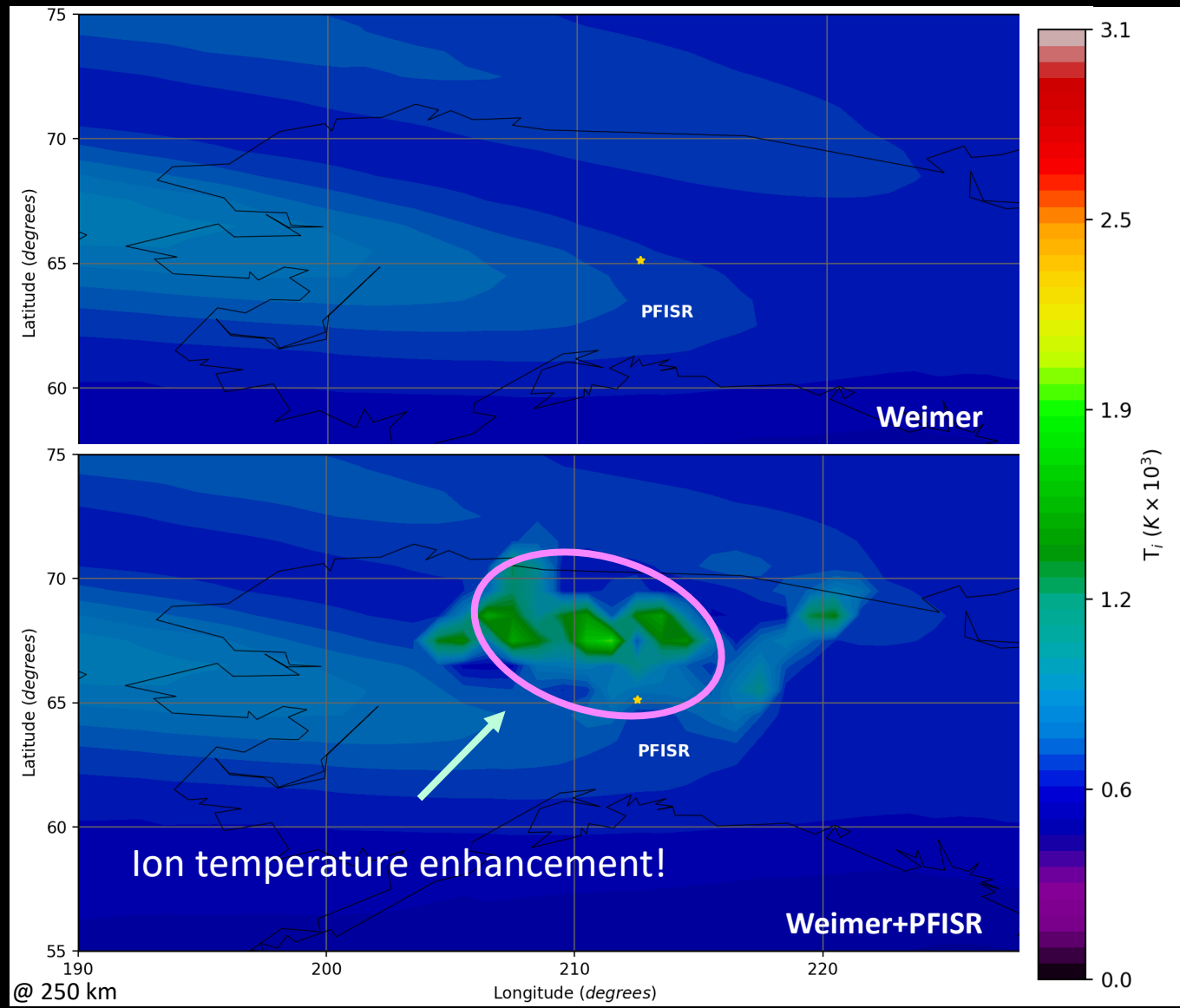
Meso-scale electric field drivers for global I-T modelling at 0655 UT





Meso-scale electric field drivers for global I-T modelling at 0745 UT

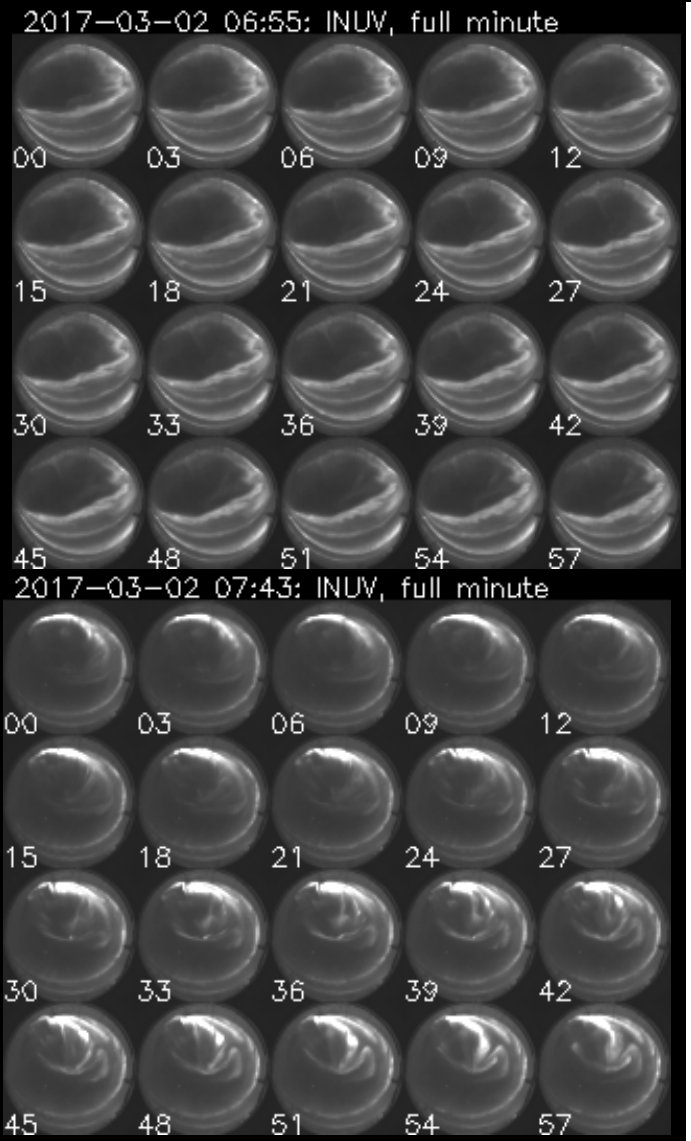


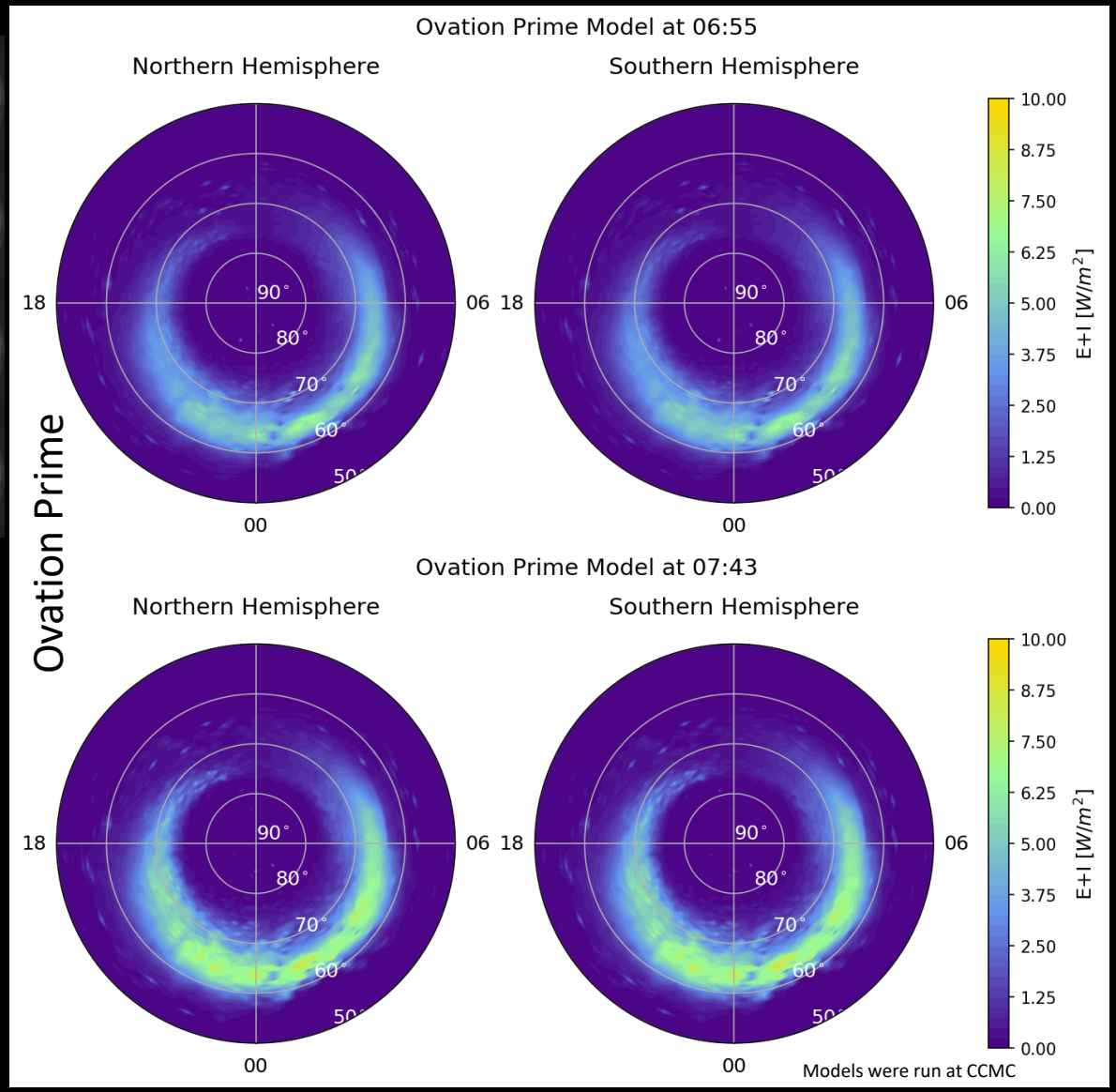


Particle Precipitation Patterns: INUVIK ASKI vs Ovation Prime Model

- Inuvik all sky imager shows very defined structures during the active periods.
- Ovation Prime model shows different responses, the 0743 UT response being more intense.

INUVIK ASKI





Conclusions:

- Electric field and particle precipitation patterns can be very dynamic, rapidly changing in meso-scales.
- PFISR electric field measurements capture the variability and can be used to drive the global I-T models.
- Simulations with PFISR driven meso-scale electric fields showed strong perturbations, such as enhancements in ion temperature.
- Roles of different magnetospheric processes on the I-T system can be identified with this approach.

>> Future direction: Investigating the roles of other meso-scale drivers such as particle precipitation

For more information Dr. Xing Meng's talk on Wednesday, 12 December 2018 09:42 - 09:54
SA31A-09: Effects of Dynamic Electric Fields Derived from Incoherent Scatter Radar on High-latitude Ionosphere